APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report No. 50-482/92-01

Operating License No. NPF-42

Licensee: Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, Kansas 66839

Facility: Wolf Creek Generating Station (WCGS)

Inspection At: WCGS, Burlington, Kansas

Inspection Period: March 10 through April 10, 1992

Inspectors: Dwight D. Chamberlain for 5-8-92
P. C. Wagner, Team Leader, Operational Programs Section Date
Division of Reactor Safety (DRS)

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Approved: Dwight D. Chamberlain 5-8-92
Thomas F. Stetka, Chief, Operational Programs Section, DRS Date

INSPECTION SUMMARY:

Areas Inspected: Special announced team inspection of the WCGS electrical distribution systems (EDS). The team evaluated the functional design and capabilities of the EDS and those mechanical systems necessary to support the EDS.

Results: Within the areas inspected, no violations or deviations for which a citation will be issued were identified. One noncited violation for the failure to follow procedures was identified and is discussed in paragraph 4.1. There were four areas identified which will require followup inspection effort. These areas are cataloged in the Attachment 1.

The team considered the EDS design to be superior and found the offsite, onsite, and battery power supplies to have ample margin for the existing electrical loads. The inspection results are further disclosed in the Executive Summary.

EXECUTIVE SUMMARY

The Nuclear Regulatory Commission (NRC) determined that the functional capability of the electrical distribution systems (EDSs) at some facilities had been compromised or placed in an uncertain condition by either imperfect design or incompatible modification. Because of the importance of the EDS in every aspect of plant operation and safety, the NRC implemented a program of performing an in-depth, EDS functional inspection (EDSFI) at each of the operating power reactor facilities. The EDSFI for the Wolf Creek Generating Station was conducted March 10 through April 10, 1992. The inspection was conducted by a team of personnel from the NRC Region IV office and consultants from Atomic Energy of Canada, Limited (AECL).

The purpose of this EDSFI was to evaluate the capability of providing necessary electrical power to required equipment during normal, upset, and accident conditions. To accomplish this purpose, the team evaluated the design of the electrical systems, reviewed the mechanical systems affecting the EDS, scrutinized the involved equipment, and examined the testing programs and their results. The inspection team implemented the guidance contained in Temporary Instruction (TI) 2515/107, "Electrical Distribution Functional Inspection," Revision 0, dated October 19, 1990, during the performance of this inspection.

The team found the overall design of the EDS to be superior. The capacities of the offsite, onsite, and battery power supplies were all determined to have ample margin for existing electrical loads. The electrical systems were found to have good redundancy and independence. In addition to their ample capacity, the emergency diesel generators were noted to have been performing reliably.

The team considered the availability of detailed design documentation to be a program strength. The records of system and component testing were noted to be very good. The housekeeping, cleanliness, and labeling, especially the labels for locked valves, was considered to be very good. The program for the control of industry information was considered to be very good; however, the implementation was not as timely as would be desirable. The internal audits of the industry information program were considered superior. The notes and precautions sections of many of the electrical maintenance procedures were considered superior.

The team reviewed numerous plant problem reports and considered the lack of documented technical basis for operability determinations to be a program weakness.

A weakness was also identified with the control and update of the information contained in the Updated Safety Analysis Report which defines the licensing basis for the facility.

Minor weaknesses were identified with the failure to assure the updating of an associated calculation when changes were made to an input calculation and a lack of thoroughness in monitoring of some mechanical systems (e.g., fuel oil system corrosion and diesel air start system dryness and cleanliness).

TABLE OF CONTENTS

SUBJECT PAGE

DETAILS

1. EXIT MEETING ATTENDEES

LICENSEE PERSONNEL

T. Anselmi, Licensing Engineer
J. Bailey, Vice President, Operations
R. Benham, Maintenance Engineer
C. DeLong, Supervisor, Quality Plant Support
M. Dingler, Manager, Nuclear Plant Engineering (NPE)
W. Eales, Manager, Electrical Systems Engineering
S. Ernest, Results Engineer
C. Fowler, Manager, Instrumentation and Control
R. Holloway, Manager, Maintenance and Modifications
S. Hopkins, Engineering Specialist
W. Lindsay, Manager, Quality Assurance
N. Little, Licensing Engineer
W. Manwaring, Engineering Specialist
O. Maynard, Director of Plant Operations
R. McMahon, NPE Engineer
C. Parry, Director of Quality and Safety
G. Pendergrass, Supervisor Engineering
J. Pippin, Director of NPE
M. Piteo, Operations Engineering Specialist
F. Rhodes, Vice President, Engineering and Technical Support
C. Rich, Jr., Supervisor, Electrical Maintenance
L. Solorio, Supervisor, Engineering
J. Weeks, Manager, Operations
S. Wideman, Supervisor, Licensing
M. Williams, Manager, Plant Support
J. Zell, Supervisor, Design Bases
J. Gearhart, Union Electric Company
B. Heinmiller, Bechtel Engineering Corporation

NRC PERSONNEL

G. Pick, Senior Resident Inspector, WCGS
P. Goldberg, Reactor Inspector, Plant Systems Section
T. Stetka, Chief, Operational Programs Section
R. Vickrey, Reactor Inspector, Plant Systems Section
P. Wagner, Team Leader, Operational Programs Section
J. Cahill, Consultant, Atomic Energy of Canada, Limited (AECL)
L. Lindley, Consultant, AECL
J. Weinberger, Consultant, AECL

2. ELECTRICAL DISTRIBUTION SYSTEMS

The team performed an evaluation of the design aspects of the EDS. The evaluation included the review of system descriptions, design reports, design calculations (including system loading, potential fault current levels, protective device coordination and setting, voltage level regulation, and equipment sizing), equipment specifications, and modification activities.

The team reviewed a sample of specific electrical design attributes for each of the ac and dc EDS voltage levels. The team's review emphasized, but was not limited to, the safety-related or Class 1E electrical components and systems. The reviews and evaluations were performed to ensure conformance with the applicable regulations, codes and standards, and to verify compliance with the WCGS Technical Specifications (TS) and Updated Safety Analysis Report.

2.1 Offsite Power Supplies

The WCGS was serviced by three, full capacity, 345kV transmission lines connected to the switchyard in a breaker-and-a-half configuration. The switchyard was also serviced by two 69kV transmission lines, one of which could be utilized as an alternate source of offsite power. The offsite power was routed to the facility through two load paths. The startup transformer was connected to the east bus of the switchyard by overhead transmission lines and provided power to two 13.8kV buses during unit shutdown conditions. The startup transformer also provided the normal source of power to one of the two engineered safety features (ESF) buses through ESF Transformer XNB02. The other ESF bus was normally energized by the west bus of the switchyard through underground feeders from Switchyard Transformer No. 7 to ESF Transformer NB01. Both of the ESF transformers could be energized through alternate load paths. A simplified diagram of the EDS is provided in Attachment 2.

During normal operations, electrical power from the main generator was supplied to the 13.8kV buses through the unit auxiliary transformer and to the switchyard through the main transformer. Provisions for the fast transfer of the power supply for nonsafety-related 13.8kV Buses PA01 and PA02, from the unit auxiliary transformer to the startup transformer upon a trip of the main turbine generator, were provided. The design also incorporated generator disconnect links which could be opened during periods of shutdown in order to backfeed offsite power through the main transformer to the unit auxiliary transformer for an additional source of onsite electrical power.

2.1.1 Grid Stability and Reliability

The team reviewed data for the 345kV transmission system to ensure that the system was capable of supplying adequate operating voltage to all safety-related and supporting equipment. The licensee provided a historical database which verified that the station supply voltage remained within the TS required range of 97- to 105-percent of nominal. The team noted that most of the transmission line outages which had occurred between 1985 and 1991 had been planned and took place during periods when the WCGS was shut down. The unplanned outages were noted to have been of short duration and to have been caused by natural phenomena such as thunderstorms.

The team also reviewed the recently completed grid stability study which evaluated incidents that could affect the 345kV system. The study indicated that the system would remain stable in the event of the loss of any one 345kV transmission line or in the event of a trip of the main generator. The study indicated that the 345kV supply to the WCGS would become unstable, however, following the loss of the two strongest transmission lines if the main generator were operating at full power during an off-peak grid condition. As a precaution for this condition, the licensee issued a contingency directive which requires the WCGS output to be reduced to a maximum of 950MW when any one of the 345kV transmission lines becomes unavailable.

2.1.2 Transformer Ratings and Protection

The 345kV/13.8kV startup transformer had a primary winding with a maximum rating of 100MVA and two secondary windings each with a maximum rating of 50MVA; Transformer No. 7 had similar ratings. The alternate source 345kV/69kV autotransformer was rated at 100MVA and the 69kV/13.8kV transformers were each rated at 14MVA. The licensee provided a copy of Design Calculation E-B-8, "Voltage Drop Calculations for Wolf Creek," which determined bus voltage levels under postulated worst-case conditions. The team noted that the calculation verified the acceptability of the transformer ratings and impedances for normal, accident, and startup conditions when the station was connected to the weakest 345kV line (Rosehill). The calculation covered a total of eight postulated scenarios and utilized the computer program "VOLTANAL." The team concluded that the transformers were appropriately rated and that the calculation was technically accurate, assumptions used were valid, and technical references were appropriate.

The team noted that surge protection was provided on all transformer windings connected to overhead transmission lines. The team evaluated the system design and equipment details and considered them to meet applicable criteria for the protection of electrical equipment against lightning strikes.

2.2 Onsite Distribution Systems

The onsite distribution system was supplied power at the 13.8kV level by the startup transformer or the unit auxiliary transformer. The engineered safety features (ESF) buses were normally supplied power through their 13.8kV/4.16kV transformers by the auxiliary transformer and Switchyard Transformer No. 7, respectively. The secondary of each ESF transformer could be connected to both ESF buses but was normally aligned only to its respective bus. Each ESF bus could also be powered from its emergency diesel generator (EDG).

The 13.8kV distribution system provided power to the very large (non-safety) motors and to 13.8kV/4.16kV distribution transformers. The 4.16kV distribution system was used for smaller process motors and as a source for the 480V system. The 480V system consisted of load centers and motor control centers and supplied the smallest process motors and plant service loads.

Power for the Class 1E components was distributed at the 4.16kV and 480V levels only. Metal-clad switchgear was used at the 4.16kV level to supply the largest safety process motors and metal-enclosed switchgear was used at the 480V level for the distribution of power to medium sized process motors and to motor control centers.

The team reviewed the onsite distribution system to ensure that adequate sources of electrical power would be available to equipment when needed. The reviews included voltage regulation, short-circuit studies, and equipment protection features.

2.2.1 Plant Operation Studies

The team reviewed the following design calculations to determine if adequate voltage levels were being maintained at the terminals of safety-related equipment under worst-case plant conditions (including degraded grid voltage):

Calculation	Title	Revision
E-B-02	Voltage Drop Calculations (SNUPPS)	0
E-B-08	Voltage Drop Calculations for Wolf Creek	3
E-B-10	Voltage Drop in MCC Circuits	3
E-B-14	Verification of Voltage Analysis at WCGS	0
E-B-15	Voltage Drop for Class 1E & Non-Class 1E MCC Distribution Transformers	1
E-B-20W	Voltage Drop During Large Motor Starting versus Feeder Cable Size	2
E-H-8	System NB Protective Relays (Degraded Grid)	3

The above calculations were prepared by the nuclear steam plant architect-engineer (Bechtel) during the design phase of the station.

The following design calculations were prepared by the licensee's engineering group:

Calculation	Title	Revision
XX-E-004	AC Motor Operated Valve Degraded Terminal Voltage	7
MA-EW-002	Load Flow Data	0

The architect-engineer's calculations used the "VOLTAMAL" proprietary computer program. The licensee's calculations were prepared manually. The team reviewed all the calculations and determined that they had been prepared in accordance with industry standards. All the assumptions made were acceptable and the references utilized were appropriate. The team determined that adequate voltage levels would be provided at the terminals of all Class 1E equipment for all postulated plant conditions.

The team noted that the licensee was in the process of upgrading the voltage drop and short-circuit calculation process and had recently purchased the "DAPPER" analytical computer program. The licensee had entered all the relevant station design data into the program data base and had completed initial computer runs. The preliminary results showed general agreement with the original calculations. This program, when fully operational, should provide a fast and accurate analysis for proposed changes to the EDS. The team considered this proactive action to be a program strength.

2.2.2 Undervoltage Protection

Bus undervoltage protection at WCGS consisted of three elements: a) instantaneous relays that trip the 4.16kV ESF bus feeder breakers on a complete loss of offsite power, b) inverse time relays which alarm on decreasing bus voltage, approaching the minimum continuous permissible voltage, and c) degraded voltage bistables which formed a part of the load shedding and emergency load sequencing (LSELS) system. The LSELS system was designed to trip the 4.16kV bus feeder breakers if a degraded voltage was not removed within a set time delay. Potential transformers (PTs) on the 4.16kV ESF buses monitored the bus voltage and provided the input to the LSELS bistables. The degraded bus voltage setpoints were determined in Calculation H-8, "System NB Protective Relays," Revision 2. Voltage setpoints were based on ensuring that the minimum voltage at the 4.16kV ESF buses would allow the downstream motor starter relays to pickup and the motors to operate. Time delays were built into the LSELS system in order to avoid spurious trips due to voltage dips during load sequencing. Additional time delays were provided to allow the operator to take corrective action. The team reviewed the design of the undervoltage protection scheme and considered it to be adequate.

The team noted that in 1991 the licensee, as part of a self assessment, had discovered an error in the degraded voltage setpoints established in Calculation H-8. Calculation B-8, "Voltage Drop Calculation for Wolf Creek," had been revised in 1985 to include a new minimum switchyard voltage, optimization of transformer taps, the deletion of the 69kV system as an analyzed offsite power source, and the addition of Transformer No. 7 in the switchyard. These changes resulted in new minimum voltage levels at the 4.16kV ESF buses which had not been reflected into Calculation H-8. Therefore, the relay setpoints calculated in H-8 had not been changed. The licensee conducted an investigation to determine whether there was a safety or operability concern as a result of this breakdown in the calculation process. The licensee concluded that the setpoints shown in the H-8 calculation were still valid. The team agreed with the licensee's conclusion. The licensee was in the process of further reviewing Calculation H-8 to determine if any adjustment of the relay setpoints was warranted. The team considered the failure to assure the updating of associated calculations (H-8) when changes were made to an input calculation (B-8) to be a program weakness.

2.2.3 Short-Circuit Capabilities and Protection

Calculation No. A-3, "Short Circuit Calculation," dated June 8,1984, was reviewed by the team. The design inputs were compared to relevant equipment data (e.g. transformer impedance, rating, voltage ratio, no-load tap changer position and grounding) which were verified during plant walkdowns from nameplate data or verified based on information in the design bases documents. The calculation methodology, assumptions and conclusions were also examined. The team also verified that the short circuit analyses included contributions for an operating EDG in parallel with its corresponding ESF station transformer. Although some minor omissions and discrepancies were noted, the calculation results were determined to be conservative.

The requirements, which were determined by the short-circuit analysis, were compared to equipment and component ratings (switchgear interrupting and load carrying capability, cable sizing, protective relay setpoints, and system coordination) to verify conformance with station design basis requirements. Calculation F-7, "Minimum Cable Sizing Based on Short Circuit Rating," dated May 31, 1983, was reviewed to assess the accuracy of references, design inputs, methods, and conclusions. The basis for specified fault durations and resulting conductor temperatures were determined to be acceptable.

The team reviewed an analysis of the interrupting and momentary ratings of the 13.8kV switchgear located in the switchyard (SL-7 and SL-8). The alignment of this equipment was relevant to the onsite power system's ability to utilize the 69kV transmission system. Based on the team's review of the documentation provided, these switchgear short-circuit ratings were determined to be adequate.

2.2.4 Circuit Breaker and Fuse Coordination

The team evaluated the settings of the various circuit breakers and protective relays on the 4.16kV, 480V and 120V systems, and their ability to interrupt potential fault currents in a coordinated manner. The scope of this review included large Class 1E motor protection, motor operated valve (MOV) feeder protection, electrical containment penetration primary and backup protection, reactor coolant pump (RCP) motor undervoltage (UV), and underfrequency (UF) protection, ESF auxiliary transformer protection, and low voltage Class 1E systems. Fast and slow bus transfer schemes were also reviewed by the team; however, the Class 1E distribution system busses were always connected to the preferred power sources which limited the significance of transfers to the extent the switchyard systems were influenced by the transient. Ground fault and bus undervoltage protection settings were also reviewed to ensure system protection and downstream coordination.

During the review of the calculations and referenced documents, the team identified one minor discrepancy in a specified value for primary current protection. This discrepancy appeared isolated and had no impact on the facility. The licensee acknowledged this discrepancy and agreed to correct the calculation.

2.2.5 Penetration Devices and Protection

The team evaluated the design of the electrical penetration assemblies' protection against overcurrents and conformance with industry guidance. The team's evaluation included the review of Specification No. 10466-E-035(Q), "Technical Specification for Electrical Penetration Assemblies for the SNUPPS," Revision 8, and Specification No. 10466-E-035B(Q), "Technical Specification for Electrical Penetration Module Assemblies for the SNUPPS,"Revision 3. The team also reviewed maximum load requirements, relay setpoint tabulations, and coordination curves. The team also verified conformance with TS requirements by reviewing test records and surveillance procedures for testing protective relay settings.

The team also verified that Calculation No. A-6-W, "Thermal Capability of Electrical Penetration Assemblies vs. Dual Short Circuit Protection to Satisfy Reg. Guide 1.63," Revision 0, demonstrated that those Conax penetration assemblies, which had replaced Bunker-Ramo assemblies, were protected.

Calculation No. A-7, "Reactor Coolant Pump Motor Electrical Penetration Assembly Short Circuit Withstand Capability," Revision 1, was reviewed to ensure that maximum load currents were analyzed and that the division of load current for each phase (two circuits per phase) had been evaluated to determine the maximum current through the penetration assembly.

Based on the above calculations and the calculations for other specific loads, the team concluded that the penetration devices and protective features were acceptable.

2.3 Emergency Diesel Generators (EDGs)

The design of the engineered-safety features (ESF) electrical power sources included two EDG sets. The EDGs were designed to automatically start and provide 4.16kV power to the associated ESF bus within 12 seconds following the loss of the normal offsite power source. Both of the EDGs were rated for a continuous load of 6201kW.

The team evaluated the load carrying capability and the protective features of the EDGs to ensure that adequate electrical power would be available to the accident mitigating and safe shutdown loads.

2.3.1 Full-Load Requirements and Capabilities

The team evaluated the load carrying capacities of the EDGs under static and dynamic conditions. The team reviewed the automatic loading sequence that would occur during an accident situation and the consequences of manually connecting additional loads onto the EDGs.

The EDG load sequencer system provided two major functions; load shedding and emergency load sequencing. The load shedding function consisted of two subsystems: undervoltage load shedding and LOCA load shedding. The undervoltage load shedding subsystem detected undervoltage on the 4.16kV ESF buses and shed selected equipment. The LOCA load shedding subsystem shed selected equipment upon presence of a safety-injection signal. The load sequencing function also consisted of two subsystems: shutdown load sequencing and LOCA load sequencing. The shutdown load sequencer actuated selected loads which were necessary to safely shutdown the plant following a loss of offsite power. The LOCA load sequencer actuated selected loads which were necessary to mitigate the effects of a LOCA and safely shut down the plant. The system incorporated various electronic circuit modules and included an automatic test circuit. The team found the system to be fully qualified for Class 1E service and built to appropriate quality assurance standards.

The team evaluated the power demand for the major pump motors that would be powered by the EDGs during an accident situation. The team utilized the manufacturer's pump performance curves and motor efficiencies to establish the required electrical power which was then converted into required diesel engine power. The team identified an inconsistency in the electrical power required for the essential service water (ESW) pump motors.

The team reviewed Drawing E-11005 (Q), "List of Loads," Revision 8, which listed the EDG loads under various postulated LOCA and station blackout conditions. The maximum total static load connected to an EDG was indicated to be 5448kW and occurred on load group No. 1 during the recirculation phase following a LOCA. This total included both safety-related and nonsafety-related loads and indicated that the EDGs had a minimum margin of approximately 12 percent. The licensee stated that there had been an increase of approximate 64kW in the safety-related load total since initial licensing of the facility.

The team noted that the EDG manufacturer (Colt) had performed a simulated dynamic loading analysis prior to the EDGs being delivered to WCGS. The team reviewed Colt Engineering Report 10466-M-018-0389-01, which provided details of output voltage and frequency variations as loads were connected in sequence to the EDG. The load values were based on the loads which were installed at the WCGS and were added at 5-second intervals. The team noted that the maximum voltage and frequency variations were 23.1 percent and 4.39 percent, respectively. These variations occurred when a load equivalent to the ESW pump motor was connected to the EDG. These values met the criteria established in Regulatory Guide 1.9. The team noted that the maximum time for the voltage to recover to the 100 percent level following the application of a load was 1.05 seconds, which was well within the period between load steps.

The above Colt report, however, indicated a load value of 1234kW for the ESW pump motor whereas the EDG load list indicated 1352kW. The licensee stated that the 1234kW value had been provided to Colt by the architect-engineer and was based on the original calculated ESW design flow rate. The flow rate had since been revised to 15,000GPM, which corresponded to a pump brake horsepower of 1675 and an equivalent motor power requirement of 1350.9kW. The load list had not been revised to indicate the new value. The team agreed with the licensee that the increased value would not affect the ability of the EDG to start the sequenced loads.

Since the EDG load list drawing was included in the USAR, the licensee agreed to have the listing corrected and included in the next annual revision to the USAR. The revision to the USAR ESW pump motive power requirements will be verified as part of a subsequent inspection. (Inspection Followup Item 482/9201-01a)

The team questioned the ability of the EDG to start the largest ESF load when carrying all other loads, as required by the EDG specification (10466-M-018). The licensee provided a copy of a test report, prepared by Colt Industries, which showed that the EDG had successfully started a 2000hp unloaded motor while supporting a resistive load of 4977kW. Since the maximum ESF load was 1350kW (ESW), the team found this report to be acceptable.

The team noted that the Colt Industries report had not taken into consideration the effects of the station service transformers' magnetizing currents when determining the initial load connected to an EDG. The licensee acknowledged that this requirement had not been included in the analysis but stated that the operational tests, which were conducted every 18 months, demonstrated the EDGs capabilities. The licensee provided strip chart recorder records of voltage and frequency taken during an actual test. These records verified that allowable excursions were not exceeded as the loads were connected.

The team also noted that the containment spray pump motors received a start signal from the EDG sequencer at the 25-second time interval, but required a concurrent signal from high containment pressure before the motors would start. The team asked if, in the event the signal from containment pressure was not present at the 25-second sequencer time but occurred a short time later, would the containment spray pump motors start at that time. The team was concerned about the possibility that two loads attempt to start at the same time and overload the EDG. The licensee stated that if the containment pressure signal was not present at 25 seconds, a time delay relay would prevent the containment spray pump motors from starting for another 25 seconds. Therefore, the motors would not start until 5 seconds after the last load was sequenced onto the EDG. The licensee indicated that a note would be added to the Load Shedding And Emergency Load Sequencing Logic diagram (Drawing No. E-02NF01) to clarify this situation. The team also questioned if the additional 25-second time delay had been analyzed in the accident consequences evaluations. The team was informed that the accident analyses assumed the additional delay in the start of the containment spray pumps.

2.3.2 Protective Relays

The EDG vendor manuals and Calculation No. H-10, "System NE Protective Relays," Revision 4, were reviewed by the team. The scope of review included the acceptability of the EDG capacity, grounding and protective relay setpoints. The team also reviewed USAR Section 8.3 and excerpts from the WCGS Safety Evaluation Report (SER) to verify the design basis for the EDG protective trips that were not bypassed during a station accident event.

Based on the documents reviewed, the team concluded the EDG protective devices were in conformance with the WCGS design basis and were adequately designed.

2.4 Battery Supplies and Distribution

The WCGS design incorporated separate dc systems for the Class 1E and the non-Class 1E loads. Each of the systems was powered by its own batteries and their associated chargers and distribution systems. The Class 1E loads were supplied from four 125V batteries; one system for each of the instrumentation channels. Two of the Class 1E batteries were rated at 1650 ampere-hours (AH), the other two were rated at 900 AH. The Class 1E batteries were all sized to have sufficient capacity to energize their respective loads for 200 minutes.

The non-Class 1E instrument and control loads were powered by four other 125V batteries. An additional 125V battery was provided for the cooling water makeup system, two 125V batteries were provided for the 345kV switchyard, one 125V battery was provided for the 13.8kV portion of the switchyard, and one 250V battery was provided for dc motor loads.

The team evaluated the capacity of, and protective devices for, the Class 1E systems to ensure that adequate power could be supplied to the necessary loads.

2.4.1 Load Requirements and Battery Capacity

The team reviewed battery sizing calculation E-3-W, "Class 1E Battery System (WCGS)," and noted that it had been prepared in accordance with current industry standards and criteria. Two of the four batteries (NK11 & NK14) were required for starting the EDGs. The calculation showed that these batteries, based on a 200 minute duty cycle, had an 11 percent margin with the battery at a temperature of 60 degrees C. The other two batteries (NK12 & NK13) had a 56 percent margin.

In addition to establishing the battery sizes, this calculation evaluated the effects of the end-of-cycle terminal voltages on the operation of the Class 1E inverters. The team noted that the calculated end-of-cycle terminal voltage for the 1650 AH batteries was 108.6V and for the 900 AH batteries was 112.8V. The worst case terminal voltage (108.6) was shown to result in an input voltage to the inverter of 106.9V. The inverters' manual stated that the acceptable range of input voltage was 105V to 140V. Therefore, the team determined that the battery capacity and the cabling system associated with the inverters were adequate.

2.4.2 Voltage Drop Calculations

The team reviewed Calculation B-9, "DC Control Circuit Voltage Drops," which was prepared during the design phase of the facility to establish maximum allowable conductor lengths for control circuits. The licensee used the minimum allowable voltage at the device terminals and an end-of-cycle battery voltage of 105V to calculate the maximum allowable conductor length.

The team also reviewed the following calculations:

Calculation	Subject
B-19-W	DC Control Circuit Voltage Drop for Power Operated Relief Valves BBPCV 455A & 456A
XX-E-005	DC Motor Operated Valve Degraded Voltage for Valves ALHV - 005, 007, 009 & 011 and Minimum Available Current for FCHV - 312

Calculation B-19-W was a special case calculation to demonstrate that modifications to the valve dc control circuitry would not prevent operation of the valve solenoids due to excessive voltage drops. The minimum allowable operating voltage for the solenoid was specified by the manufacturer as 90V. The calculation showed that 91.3V would be available at the solenoid terminals with the battery at its discharge level of 105V.

Calculation XX-E-005 was prepared in response to NRC Generic Letter 89-10. Valves ALHV - 005, 007, and 009 utilized Limitorque Modutronic control units. These devices converted 120V ac into dc which was then supplied to the valve operator motor. The Modutronic unit provided a means of finer control of the valve position. The 120V supply was provided by a 480V Class 1E MCC through a distribution transformer. Valve FCHV - 312 utilized a normal dc motor-driven actuator and operated off the Class 1E 125V dc system. The calculation for the Modutronic-operated valves considered the voltage drop from the 480V load centers through an MCC and a transformer to the valve operator terminals. The calculation showed that the voltage at the valve operator terminals was adequate under the postulated degraded voltage conditions at the 4.16kV Class 1E buses. The calculation for Valve FCHV - 312 showed that the current available to the valve operator motor when the battery was at its discharged value of 105V was sufficient for the motor to deliver the required torque.

2.4.3 Ground-Fault Detection

The team noted that a ground detection system was provided for each Class 1E 125V dc bus. This system consisted of a GE Type NGV ground relay and auxiliary relays which provided an alarm when a ground occurred on either a positive or negative bus. A fault locating system and system testing capabilities were also provided. The system allowed an operator to locate the actual dc circuit which had a ground fault. Two alternate methods of locating the ground were also provided; one used a high frequency signal and an oscilloscope and the other used a dc pulse milliampere current signal. The team evaluated the ground detection and the ground location systems and found them to be acceptable.

2.4.4 Coordination and Protective Relays

The team reviewed the dc system short-circuit analysis, equipment and component ratings, and system protective-relay settings and coordination. During the inspection, the licensee developed and issued Calculation No. NK-E-003, "Class-1E 125V DC Batteries Short-Circuit Study," Revision 0. The team reviewed this calculation and the specifications for the batteries, dc distribution switchboards and dc distribution panels.

The team identified errors in two of the dc system calculations. Calculation No. H-12, "System NK Relay Setting," Revision 4, incorrectly stated "that the undervoltage alarm setting for the 125 volt dc busses could be anywhere between 90V and 140V." Since the minimum allowable design-basis voltage at the switchgear was 90V, the corresponding value at the distribution switchboards must be higher to allow for the voltage drop in the feeder cables. The licensee agreed and will revise the calculation. Also, a comparison of battery cell jumpering calculation No. NK-EW-002, "NK11, 12, 13, and 14 Cell Loss Assessment," Revision 0, with Calculation No. E-3-W, "Class 1E Battery System," Revision 1, revealed that an assumed minimum required battery terminal voltage of 105V in the former calculation was incorrect. The licensee demonstrated that the conclusions of Calculation No. NK-EW-002 were not affected but agreed to correct the assumed value.

The team reviewed the coordination curves for the dc system and concluded that the circuit breaker and fuse coordination design were acceptable. The relay setting documents were also reviewed and found to be acceptable.

2.4.5 EDG Field Flashing

The licensee's evaluation of the EDG field flashing circuitry showed that 112.4V would be available at the local terminals when the battery voltage was at 125V. The team asked if adequate voltage would be available at the EDG field flashing circuit terminals under worst-case conditions. The generator voltage regulator manufacturer, Westinghouse, had stated that the minimum voltage required to flash the EDG field was 100V. The licensee prepared a new evaluation which utilized preliminary information from Westinghouse. (The information was preliminary because it had not been confirmed by Colt the EDG manufacturer.) The licensee performed a more detailed assessment of the wiring used in the circuitry and determined a lower circuit resistance was appropriate. A new analysis showed that the voltage at the field flashing circuit terminals would be 100V when the battery voltage was 105V. The team accepted these conclusions based on the conservatism used in the calculation.

2.4.6 Inverters Capacity and Protection

A separate safety-related (Class 1E) inverter was provided to supply power for each of the four channels of vital instrumentation and control loads. Each of the inverters was rated 7.5kVA with a single phase output of 120V, 60 Hertz. The 125Vdc input to the inverters was provided by the Class 1E battery associated with that instrument channel. Alternate ac supplies were available through manual transfer switches from regulating transformers connected to the 480Vac Class 1E system.

In order to verify that the rating of the inverters was adequate, the team reviewed details of the loading on the inverters during normal and LOCA conditions. The licensee determined the loading values during normal operating conditions by measuring the current readings for energized loads and by utilizing data from manufacturer's drawings and manuals. The additional loads which would occur as a result of a LOCA were calculated from the manufacturer's data. The team reviewed a preliminary copy of Calculation NN-E-001, "Class 1E NN Inverter Loading," during the inspection.

Based on the values calculated from the manufacturer's data, the inverters would be overloaded, however, the team did not consider this information to be realistic. The team's determination was based on the conservatism utilized in the calculation. For example, an instrument rack was assumed to contain the maximum number of components even though a number of racks were only partially filled. When the realistic current values were used, the maximum loading on an inverter was 5887VA. The licensee was continuing to update their calculation and based on the conservatism contained in the calculations they were confident that the inverters were adequately sized. The team also considered that the inverters were adequately sized.

The licensee stated that the inverter load list drawings would be revised to reflect the loads determined by the finalized calculation. The drawing revisions will be verified during a subsequent inspection. (Inspection Followup Item 482/9201-02)

The team also reviewed Calculation No. H-18, "System NN Relay Settings," Revision 1, to determine the adequacy of the protective relay settings for the 120V vital bus system. Based on the documents reviewed the team determined the protection settings were acceptable.

2.5 Conclusions

The team concluded that the overall design of the EDS was superior. The offsite power supplies were considered to be stable and reliable. The distribution system redundancy, independence, and protection were found to be good. The capacity of the offsite, onsite, and battery powered supplies were found to include ample margin for the existing loads.

With few exceptions, the licensee was able to readily make available detailed design documents. The team considered the design records to be a program strength.

3. MECHANICAL SYSTEMS

The team evaluated the capability of selected mechanical systems to properly support the functioning of the EDS. The inspection concentrated on the functional capability of the emergency diesel generator's engine and the support systems necessary for the proper operation of the engine. The team also evaluated other mechanical systems which could effect the functional capability of other portions of the EDS.

3.1 Emergency Diesel Genratcr (EDG) Engines

The EDGs were driven by Colt-Pielstick, 14 cylinder, Type PC 2.5V diesel engines which were designed to start and accept loads within 12 seconds. The engines were equipped with Woodward EGA/EGB-5C electro-hydraulic speed governors.

3.1.1 Engine Loading

The team reviewed the principal pump motors powered by the EDG to confirm that the correct motor power had been used in sizing calculations. The team reviewed the auxiliary feedwater pumps, component cooling pumps, centrifugal charging pumps, containment spray pumps, essential service water pumps, residual heat removal pumps, and safety injection pumps. The team utilized the manufacturers pump performance curves and motor efficiencies to establish the required electrical power.

The performance curves for the ESW pumps showed that at runout conditions the pump load was 1900hp and the pump motor required 1530kW. This value was 159kW greater than the data identified on Drawing E-11005(Q), "List of Loads Supplied by Emergency Diesel Generator," Revision 8. The licensee, however, provided calculations to demonstrate that the actual system resistance under various operating scenarios would restrict runout flow to approximately 17,000 GPM as opposed to the runout flow shown on the manufacturer's pump curves. The team accepted that at this runout condition the power required by the motor would be close to the 1371kW identified on the load list. The team identified no other significant problems in the calculated maximum EDG loading and concluded that the 6201kW continuous rated load capability of the EDGs had an adequate safety margin over calculated values for various accident scenarios.

3.1.2 EDG Support Systems

The team reviewed Calculation M-JE-321, "Emergency Diesel Storage Tank and Day Tank Volumes and Level Settings," Revision 1, along with instrument uncertainty setpoint calculations to determine if the respective tank capacities complied with the requirements of the USAR and Technical Specifications (TSs). The team noted that USAR Section 9.5.4.2.2(c) specified that the day tank contained sufficient capacity for 1.5 hours operation at continuous rating. This capacity was determined by the team to be approximately 711 gallons and was greater than the gross tank capacity of

621 gallons established by Calculation M-JE-321. The licensee agreed to clarify the volume requirements for the EDG fuel oil day tank contained in the USAR in the next annual revision. The clarification of the day tank volume requirements will be reviewed during a subsequent inspection. (Inspection Followup Item 482/9201-01b)

Several inconsistencies were noted by the team between instrument uncertainty calculations, fuel oil setpoint calculations, and safety related setpoint drawings and procedures. Calculation JK-JE-01, "Instrument Uncertainty Estimate and Safety Related Setpoint(s)," Revision 0, established an incorrect pump start setpoint value of 45 inches of water column, whereas K05-004 the "Total Plant Setpoint Document," identified this value as 34.15 inches of water column. The error was determined to be in the instrument uncertainty calculation which had been corrected on the latter document. Further minor inconsistencies were noted between setpoints established by calculation M-JE-321 and the actual plant setpoint documents and drawings. These inconsistencies were, however, on the conservative side and had no impact on the required minimum alarm or pump start/stop setpoints. The licensee agreed to review and revise the respective documents to ensure total consistency.

The team also reviewed the onsite fuel oil storage capacity and determined that the fuel oil storage tank contained sufficient margin at the low level alarm setpoint to ensure the minimum 85,300 gallons required by the TSs. The team noted that the fuel oil storage tanks and parts of the system piping were buried underground and that no specific checks for corrosion products were required. The licensee issued Service Request EM-269, dated March 3, 1992, to ensure that the maintenance and modification group visually inspected the interior of filter housings for corrosion products. The team also noted that the TSs required the tanks be pressure tested at 1.1 times the system design pressure at 10-year intervals.

The team noted that combustion products from each EDG were exhausted to independent exhaust stacks located on the roof of the building. The stacks projected approximately 50 feet above the building roof and were separated by approximately 30 feet. The team was concerned that a missile impact could cause the stacks to collapse against each other and potentially block the combustion exhaust from both engines. The licensee, however, demonstrated that the location, size, thickness, and support of the stacks along with the surrounding power block structure afforded adequate protection against the probability of such an event.

The starting air system for each EDG was supplied by two independent air trains consisting of a compressor, desiccant drier, air-start receiver, and filters. Section 9.5.6.2.2 of USAR stated that the desiccant drier (including pre-filter and after-filter) provided moisture free air at a dewpoint of -40°F. The system was additionally fitted with wye type strainers capable of 149 micron particle retention. Since the system was designed to provide instrument-quality air, the team considered this to be a design strength. However, the licensee had neither established EDG manufacturer minimum air quality requirements nor were monitoring to ensure those requirements were being met. Furthermore, the licensee drained moisture from the receivers infrequently and did not check for corrosion products in the effluent. The team discussed this concern and the licensee issued Performance Improvement Request (PIR) 92-0322, dated March 22, 1992, to monitor the dewpoint and inspect for corrosion products during receiver blowdowns.

The team also evaluated the air start system's ability to successfully start and accelerate the engine to 514 rpm in less or equal to 12 seconds. In addition, the ability of each air receiver to provide a minimum of 5 starts and of the compressors to recharge the receivers within 30 minutes was reviewed. Test results provided by the licensee confirmed that the system was capable of successfully achieving those requirements.

3.2 Other Mechanical Systems

The team reviewed various mechanical systems that could have an effect on the proper operation of the EDS. These reviews included cooling water and ventilation systems.

3.2.1 Essential Service Water System (ESW)

The team reviewed the ESW System and questioned if the air normally trapped in the dormant section of piping between the ESW pump and its self-cleaning strainer would enter the system during startup. The licensee demonstrated that trapped air would be automatically vented during the startup sequence before the main header discharge valves were opened. In addition, the team reviewed the time required to automatically isolate the service water system from the ESW. The team was concerned that an excessively long closing time could potentially starve flow to the heat exchanger or cause pump cavitation problems if a pipe break occurred on the service water side of the valve. The team noted that the valve closing time of 45 seconds posed no problems to the function of the ESW because the isolation valves would be sufficiently closed during the ESW startup time of 35 seconds.

3.2.2 Heating, Ventilation, and Air Conditioning (HVAC)

The team noted that Table 9.4.1 of the USAR specified the extreme outdoor design temperature of -60°F. Calculations were not available to indicate what temperature would be seen in the EDG room, when the EDG was not operating, with such extreme outside ambient conditions. Similarly, under such extreme design conditions no assessment had been made of the operability of ventilation equipment such as fan motors, electrohydraulic actuators, etc. The team was informed that the extreme temperature condition had been included because the standardized design included proposed facilities located in more Northern climates. The team agreed that it was unrealistic to postulate such extreme design conditions and agreed with the licensee's proposal to review this section of the USAR and establish more realistic conditions for the plant vicinity.

The licensee agreed to include a correction to the ambient temperature design values as part of the next annual revision of the USAR. The revision of the design temperature value will be verified during a subsequent inspection. (Inspection Followup Item 482/9201-01c)

Each EDG room was ventilated by a once-through type system. Supply, recirculating, and exhaust air dampers controlled airflow such that the actual outside air introduced by the fan into the building varied from 120,000 cfm in summer to 30,000 cfm in winter. The air inlet and recirculating damper operators were electro-hydraulic controlled and exhaust dampers were pneumatically controlled. The team determined that the instrument air supply to the pneumatically controlled exhaust dampers was not safety related and that a common air header supplied the operators in both EDG rooms. Upon a loss of the instrument air supply, the dampers were designed to fail in the open position. With the exhaust dampers open and a wind velocity of 15 mph (Table 9.4.1 of USAR) flow rates into each EDG building through the exhaust louvre would be very high. Such infiltration of outside air at a realistic winter design minimum temperature of -24°F would cause subzero conditions in both EDG rooms. The team was concerned that this scenario had been not been analyzed and that the potential existed for common mode failure if the EDGs failed to start at low room temperatures.

In response to the team's concern, the licensee revised Procedure STS CR-001, "Shift Log for Modes 1, 2 & 3," Revision 14, to require, in part, that the operators monitor low room temperatures every 30 minutes and start the EDG if the room temperature went below 50°F.

To protect against subzero conditions in the essential service water (ESW) pump rooms, the licensees included revisions to the above shift log procedure to also require that the ESW pump room temperatures be logged every 30 minutes if temperatures below 50°F were indicated in the control room. If the pump room temperature decreased below 40°F, the procedure required the appropriate ESW pump to be started. The team considered this to be acceptable additional protection against single failure of ESW pumps.

During a walkdown of the battery rooms, the team noticed that there were no fixed temperature monitors installed and also determined that the room temperature was logged only once a week. The team was concerned that temperatures above or below the design limits could go undetected for a long period of time. The licensee provided Procedure CKL ZL-004, "Revised Log and Daily Reading Sheets," dated March 3, 1992. The revised procedure required each battery rooms' temperature to be logged at least once each shift. The licensee also installed a temperature measuring device in each battery room. The team also noted that the battery rooms were equipped with hydrogen detectors that alarmed in the control room if high concentrations were detected. The team, therefore, determined that adequate protection existed for these rooms.

3.3. Conclusions

The team concluded that the design and operability of the mechanical supporting systems for the EDGs were adequately demonstrated during the course of the inspection. The systems, in general, were conservatively designed. However, the team noted a lack of thoroughness in surveillance in some instances. The fuel oil system, for example, was not checked for corrosion products and no surveillance was carried out on the air start system to ensure air dryness and cleanliness were being maintained. Design information had, in some instances, been included in the USAR without a clear assessment of its acceptability. This was noted particularly in specifying an outdoor design condition of -60°F and in the ESW flow rate requirements discussed in paragraph 5.2.3, below.

4. EQUIPMENT TESTING AND SURVEILLANCE

The team reviewed the testing requirements and test results for equipment included in the design reviews discussed above. The team also performed physical inspections of the involved equipment. These activities were conducted to ensure that the equipment was being properly maintained and controlled.

4.1 Emergency Diesel Genrators (EDGS)

The team reviewed applicable operating and surveillance test data in order to evaluate the overall reliability of the EDGs. The team also verified that the surveillance and test procedures met the requirements of the Technical Specifications (TSs).

The team noted that Procedure ADM-01-241, "Trending," Revision 0, dated December 19, 1991, described the general program for trending and reporting. The procedure stated that component trending should be implemented based on the impact on plant safety and reliability to the extent that personnel resources would permit performing the trending activity. The EDG maintenance engineer started a trending program in December 1990. The team found the program to be comprehensive and meaningful. Some of the parameters trended were starting air differential pressure, cylinder exhaust temperature, engine start time, and differential pressures across various filters and strainers. The team also noted that the maintenance engineer generated quarterly reports on the status of the EDGs. The team considered the efforts of the EDG maintenance engineer in performing EDG trending to be a program strength.

The team reviewed the EDG Reliability Reports for 1990 and 1991, and noted that the reliability of both EDGs had been greater than 97 percent since 1985, and that an improving trend was indicated. The reliability of the EDGs was calculated in accordance with Regulatory Guide 1.155, "Station Blackout."

The team reviewed a sample of the test data for the monthly and the 18 month EDG tests and found that the test data had been properly completed and reviewed. The team verified that all of the parameters were within the TS requirements.

During the review of the "B" EDG monthly test dated September 5, 1991, the team noted that the "A" starting air tank pressure had decreased considerably during the diesel start. The pressure had dropped 320 psi during the September test as compared to 80 psi during the previous monthly test. The licensee did not evaluate this large drop in air pressure until 15 days after the actual test. A work request (WR) was generated and the air start solenoid valves, which had been replaced just prior to the September test, were found to have shipping plugs left in vent ports. These plugs, which should have been removed, caused the valves to remain open longer than normal resulting in the large pressure drop in the air tank. The licensee removed the shipping plugs and revised the monthly test procedures (STS-KJ-005A [B], "Manual/Auto Start, Synchronization and Loading of EDG A [B]," Revision 13) to require that the starting air tank pressure drop not exceed 100 psi. The licensee also revised procedure ADM 02-300, "Surveillance Testing," to require prompt test data review.

During the review of EDG monthly test data dated February 5, 1992, the team noticed that the time for the generator to reach 60±1.2 Hertz was documented to be 10.75 seconds. However, paragraph 2.9 of Procedure STS-KJ-005B, required a WR to be initiated if 60±1.2 Hertz was not achieved within 10 seconds. When asked for a copy, the licensee stated that a WR had not been initiated as required. The licensee prepared a Problem Improvement Request (PIR) OP 92-0305, which evaluated the reason the WR had not been prepared and recommended a change to the procedure to more clearly specify the requirement to generate a WR. The licensee revised Procedures STS-KJ-005A and STS-KJ-005B, to incorporate a note on the start time data sheet which stated "refer to paragraph 2.9."

Since TS 6.8.1 required written procedures to be established, implemented, and maintained, the failure to properly implement the requirements of Procedure STS-KJ-005B was a violation of the TSs. However, the licensee implemented acceptable corrective actions when the violation was identified and the occurrence had limited safety implications; therefore, in accordance with 10 CFR Part 2, Appendix C, Article VII.B, no citation is being issued for the violation.

As part of the team's evaluation of the adequacy of the stored EDG fuel oil supply, the calibration procedure for the storage tank level transmitters was reviewed. Procedure STN IC-256A, "Calibration of Emergency Fuel Oil Storage Tank A Level Loops," Revision 5, was verified to incorporate the calibration guidance provided in the vendor technical manual. However, the procedure utilized a spare ultrasonic transducer for determining the instrumentation loop response. The team noted that the installed transducer was only being checked to properly respond to the tank level that existed when the transducer was reconnected to the instrument loop following loop calibration. The team was concerned that this one point calibration check may not provide adequate assurance of proper response over the full range of measurement. The licensee discussed the concern with the instrumentation manufacturer and was informed that the calibration procedure was adequate. The manufacturer stated that the transducer was a passive device which would produce either an erratic or no signal if it were not functioning properly. The team recognized the difficulty in removing the installed transducer from the storage tank in order to verify its calibration over a wide range and found the licensee's position to be acceptable.

In addition, fuel oil sampling procedures and surveillance test results were reviewed by the team to verify that new fuel samples were within ASTM specified ranges for kinematic viscosity, flash point, API gravity particle contamination, and water and sediment, prior to addition to the storage tank.

The team noted that sampling was being carried out according to procedural requirements and when results did not meet specified requirements the batch was rejected.

4.2 Batteries, Chargers and Inverters

The team reviewed the following battery testing procedures: STS MT-18, "Weekly Inspection of 125 VDC Lead-Calcium Batteries," Revision 7; STS MT-019, "125 VDC Class 1E Quarterly Battery Inspection," Revision 7; STS MT-020, "125 VDC Battery Inspection and Charger Operational Test," Revision 10; STS MT-021, "Service Test For 125 VDC Class 1E Batteries," Revision 6; and STS MT-022, "5 Year 125 VDC Battery Discharge Test," Revision 6. The team verified that the testing requirements were in accordance with the licensee's TSs and the recommendations of IEEE 450, "Recommended Practice for Maintenance Testing Large Lead Storage Batteries for Generating Stations and Substations." The team found these, and other related testing procedures to be well written with clear instructions presented in a logical order.

The testing records for the batteries were examined and no abnormalities or problem areas were identified. Both the Class 1E battery rooms and the switchyard battery room were noted to be free of debris and all of the batteries appeared to be well maintained.

4.3 Undervoltage and Protective Relays

The team reviewed several relay test procedures and their associated test records. The procedures contained appropriate instructions to verify proper operation and correct relay settings and/or calibration of the relays. Records reviewed were found to have appropriately documented the results within the specified acceptance criteria. Although a formal relay trending program had not been established, the licensee had trending records on selected relays. In addition, relay test results were handily filed to provide a ready historical reference for review and comparison to the most recent test results.

4.4 Circuit Breakers and Switchgear

The team reviewed Procedures STS MT-028, "5-Year Breaker Inspection," Revision 10, and MPE E009Q-02, "Inspection and Testing of 13.8 KV and 4.16 KV Circuit Breakers," Revision 11. The procedures provided detailed instructions for cleaning, inspecting, and adjusting the circuit breakers and the associated switchgear. However, the team questioned the licensee's use of the term "Snug Tight" for checking electrical and mechanical connections. The licensee was unable to demonstrate that the term "Snug Tight" had a defined value. The licensee subsequently initiated action to define the term in the precautions and notes section of applicable procedures.

The team reviewed the licensee's response to recent circuit breaker information notices and found that the licensee had initiated evaluations in accordance with their Industry Technical Information Program (ITIP). The team's review of the licensee's circuit breaker procedures found them to have appropriate instructions to address the concerns of selected NRC Information Notices.

4.5 Fuse Control

The team noted that the licensee had identified the lack of a formal fuse control program and had determined that improvements were needed. In late 1990, the licensee assembled a task force to evaluate various fuse problems. As a result of the fuse inspection task force findings, the licensee established a program to monitor the status of installed fuses. Under this program, licensee quality control inspectors recorded fuse information from fuses encountered during the performance of normal work activities. The information recorded included fuse type, model, size, manufacturer, class, voltage and current rating, and any other identification, labeling or reference document information. Various fuse problems had been identified and action was taken to correct the specific problems. In addition, the licensee was evaluating fuse problems for root cause and reportability as appropriate to the specific occurrences.

The team reviewed several fuse problem evaluations and determined that the licensee was taking positive steps to resolve fuse related problems. The licensee was evaluating the adequacy of the existing fuse control mechanisms to determine appropriate recommendations for an adequate fuse control program. The licensee was scheduled to have the fuse control program implemented by June 30, 1992.

The establishment and implementation of a fuse control program was initially identified in NRC Inspection Report 50-482/91-36 and will be further evaluated in response to Inspection Followup Item 482/9136-05.

4.6 Walkdown Observations

The team performed physical inspections of the involved equipment and walkdowms of the involved systems. The team made the following observations during those activities.

4.6.1 Electrical Equipment

The team performed detailed walkdowns of the safety-related switchgear rooms, battery rooms, diesel generator rooms, electrical penetration areas, and the switchyard. The above areas were inspected for general cleanliness, accessibility, equipment condition, equipment labeling, and conformance to general electrical design and installation criteria.

All areas inspected were generally clean and the equipment was appropriately labeled. The team found the drawings used to facilitate the walkdowns to be clear, traceable, and to reflect the observed configuration.

The team also evaluated the licensee's procedures for the control of switchyard work activities. The WCGS switchyard had two designated driving lanes to be used by vehicles moving about the yard. Driving techniques were covered in the KG&E Safety Manual. In addition, WCGS Standing Order 23, "Control of Switchyard Maintenance," Revision 2, provided detailed vehicle control for inside the switchyard. KG&E Instruction Letter No. 21, "WCGS Substation/Switchyard Directive," Revision 4, established responsibilities and defined necessary interfaces, communications and coordination with KG&E to provide switchyard protection, safety, and reliability.

During the walkdown activities inside the facility, the team noted that a fastener was missing from the upper right hand corner of each cubical door on 4160V Class 1E switchgear. The licensee determined that the equipment design guidelines required three point latches with retainers on each cubicle door. The team verified that the latches met the design guidelines and had no further concerns in this area.

The team questioned the acceptability of a large metal equipment storage locker (gangbox) located in the room containing ESF switchgear NB02. The licensee was unable to locate any previous analysis to verify the acceptability of locating the gangbox in the switchgear room and, therefore, performed a new evaluation. The licensee determined that the gangbox would not overturn or move during postulated earthquakes and that any rocking motion would not impact the switchgear. The team reviewed the licensee's evaluation and found it to be acceptable. The team also verified that the placement and contents of this and similar gangboxes were being controlled by plant procedures.

4.6.2 Mechanical Equipment

The team conducted walkdowns of the mechanical components associated with the EDGs. The walkdowns included an evaluation of the general cleanliness, equipment condition, and conformance to the mechanical design and installation criteria for both EDGs. The team performed detailed walkdowns of the starting air, jacket cooling water, lubricating oil, and fuel oil systems of the "A" EDG. The team also conducted walkdowns of the pump rooms of the essential service water system (ESW) and locked open ESW valves to and from the EDG coolers.

The team found the general housekeeping to be good in both the EDG rooms and the ESW pump rooms. The licensee stated the EDGs were wiped down daily to ensure any fuel or lubricating oil leakage would be found and monitored or corrected. During the detailed walkdowns in the "A" EDG room, two check valves in the starting air system (V711A and V712A) did not have identification tags. Also, the jacket water heater outlet relief valve (V771A) was missing an identification tag. The licensee initiated steps to install tags on those valves.

During the walkdown of the EDG lube oil system, the team observed that the relief valve on the discharge side of the lube oil keep warm pump was mounted in a horizontal position instead of the normally expected vertical position. The relief valve was manufactured by J. E. Lonergan Company to the 1977

Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Class 3. The 1977 Edition specified that spring loaded pressure relief valves be connected to stand in vertical position. A review by the inspector revealed that in 1984, the valve was installed in the lube oil system in accordance with the diesel manufacturer's drawings and the 1974 Edition, Summer 1975 Addenda of the ASME Code, Section III, Class 3. This Code year did not address the orientation in which pressure relief valves should be mounted. The team reviewed documentation from the valve manufacturer which recommended that the valve be mounted in a vertical position. The licensee prepared Work Requests (WRs) WR-1C00-92 and WR-2000-92, to further evaluate the horizontal positioning of the relief valves. The WRs included an operability evaluation which concluded that the failure of the relief valve was not an EDG operability concern. The team agreed with the licensee's operability determination.

The licensee's resolution of the relief valve mounting issue will be evaluated during a subsequent inspection. (Inspection Followup Item 482/9201-03)

The team walked down the ESW valves for the cooling water inlet and outlet to the EDG coolers. The team found the valves to be properly locked and tagged in the open position. The team noted that the licensee's locked valve program utilized color-coded tags to denote the position of the locked valve. This color-coded tagging was considered to be a program strength.

During a walkdown of "B" EDG room, the team noticed a significant amount of plastic drop cloths hung and taped to the scaffolding to protect the safety-related equipment from ongoing painting activities. Some of the scaffolding and plastic were within 4 feet of the diesel air intake. The inspectors were concerned that the plastic could be sucked into the EDG air intake. The team questioned the licensee about the operability of the EDG with the scaffolding and plastic drop cloths in the room. The team was informed that the scaffolding had been evaluated on WCGS scaffolding requests, however, there was no written operability evaluation for the plastic. The licensee stated that the shift supervisor had been informed when the plastic was installed and that a maintenance engineer had determined that the EDG was operable based on his engineering judgement. The team witnessed the monthly test of "B" EDG and verified that the air movement a few feet away from the EDG air intake was probably not sufficient to draw the installed plastic into the air intake. The team, therefore, agreed with the operability determination but considered the lack of documenting the basis for the operability determination to be a weakness. The licensee revised the painting procedure, CNT-641, "Field Painting," Revision 1, to require the shift supervisor to initial and date the acceptability of preparations prior to the start of work. The plastic and scaffolding were removed when the painting was completed.

4.7 Conclusions

The team concluded that, in general, the inspected electrical and mechanical equipment was well maintained and that the general housekeeping practices were quite good. The team noted that almost all of the equipment was properly designated with identification tags or label and considered the locked valve position indication labelling to be a strength. The lack of a documented technical basis for the EDG operability determination was considered to be a weakness. The team also considered the notes and precautions sections of many of the electrical maintenance procedures to be superior.

5. ENGINEERING AND TECHNICAL SUPPORT

The team monitored the engineering products as part of the design reviews discussed above in order to evaluate the performance of the engineering support being provided to the facility. The team also reviewed the licensee's control of vendor and industry information to ensure that this information was being incorporated into facility instructions. In addition, the team reviewed engineering evaluations which could affect the EDS.

The evaluations of the engineering organizations were somewhat more limited than those conducted at other facilities because of the heavy workload by licensee personnel needed to resolve plant restart issues and because of the additional inspection initiatives in the engineering and technical support areas that had been scheduled for the near future.

5.1 Control of Vendor and Industry Information

The team reviewed Procedure KGP-1311, "Industry Technical Information Program," Revision 2, dated July 16, 1990. This procedure established the guidelines for the licensee's review and analysis of industry technical information that originated from external sources. The procedure applied to information from equipment and services vendors and from sources such as other utilities and the NRC. The procedure established the responsibilities for the review and verification of corrective actions as well as requirements for monthly status reports and safety committee oversight.

The team also reviewed the procedures related to the receipt, applicability review, and incorporation of provided information and found them to be sufficiently detailed and understandable. The team noted that annual audits of suppliers was required and that the audit included a verification that all applicable changes and product information letters had been received by the facility. The team observed that the report of the licensee's quality assurance audit (TE: 50140-K279) performed in 1990, expressed a concern with the timeliness of both the applicability determinations and the implementation of provided guidance. The team noted that the site engineering organization had intervened in October 1990 to reduce the backlog of and lessen timeliness concern.

The team discussed the results of the in-progress quality assurance audit (TE: 50140-K353) with the audit team leader. The audit disclosed two strengths and three weaknesses. The audit team continued to be concerned with the timeliness of program implementation. The audit team leader stated that the audit report would contain four recommendations for program improvement.

The team evaluated the implementation of the licensee's control of vendor information as part of the reviews of vendor manuals and during the design reviews and equipment inspections discussed above. There were no problems identified during those reviews.

5.2 Engineering Evaluations

In addition to the review of design documentation discussed above, the team examined the engineering evaluations related to selected maintenance and modification activities.

5.2.1 ESW Motor-Operated Valves

During the walkdown of the essential service water (ESW) pumphouse, the team noted the existence of numerous work request (WR) tags on various pieces of equipment. The team was concerned because some of the tags indicated that a questionable condition had been identified a significant time earlier and had not been corrected.

The team found work request tags on some MOVs in both pump rooms. WR 2291-91, dated June 12, 1991, was initiated because the gear operator of the "A" ESW self-cleaning strainer trash valve had dark and runny grease. WR 2293-91, dated June 12, 1991, was initiated because the gear operator of the "A" ESW pump discharge air release valve also had dark and runny grease.

The WRs stated that the grease was the original manufacturer's grease and would require replacement. The licensee stated the grease had not as yet been changed because the problem was not considered to be high priority. The team noted that the documented operability determination consisted of one block checked on the WR form which indicated that the equipment was operable. There was no written evaluation and the shift supervisor apparently made the operability determination without concurrence from engineering personnel. The team considered the lack of documentation of the operability determination to be a weakness.

5.2.2 ESW Self-Cleaning Strainers

The team reviewed WR 01249-92, which identified a problem with the ESW self-cleaning strainers. Because of the significant distance between the ESW pump house and the control room, the electrical losses in the control wiring for the strainers could result in the inoperability of the automatic backwash feature of the strainers under abnormal grid voltage conditions. In response to this problem, the licensee initiated Plant Modification Request (PMR) 04232 on March 15, 1992. The PMR proposed modifications to the strainer control circuitry to eliminate the need for control cabling between the control room and the pump house. The modified design would provide direct control of the backwash control valve by installing a new differential-pressure switch on each of the strainers. In the interim, the control room operators had been directed to manually backwash the strainers in the event of a high differential-pressure alarm. The licensee stated that the control circuitry modifications would be completed in May 1992.

The team found the proposed actions to be acceptable and had no further questions in this area. The completion of the modifications to the ESW self-cleaning strainers' control circuitry will be verified during a subsequent inspection. (Inspection Followup Item 482/9201-04)

5.2.3 ESW Heat Exchanger Flow Rates

The team reviewed WR No. 6386-91, dated November 24, 1991, for safety-related heat exchanger flow rates. During a normal flow verification test, a number of safety-related heat exchangers did not meet the required flow rates specified for normal operating conditions listed in Table 9.2-2 of the USAR. The licensee stated that the heat exchangers were acceptable with the as-found flow rates because the minimum cooling requirements were met. The licensee also stated that the heat exchangers met the required flow rates for the post-LOCA conditions. The team reviewed the post-LOCA flow rate tests and verified that the required flow rates were met. The team was concerned that some of the licensee personnel stated the opinion that the flow rates listed in USAR Table 9.2-2 were nominal values and not the minimum required flow rates. The information contained in the USAR provides the licensing basis for the facility and should be consistent with the design requirements.

The licensee agreed to correct the ESW flow requirements for normal operating conditions listed in USAR Table 9.2-2 as part of the next annual revision. The revision of the flow requirements will be verified during a subsequent inspection. (Inspection Followup Item 482/9201-01d)

5.3 Conclusions

The team concluded that the engineering and technical support being provided by the licensee for the operation of the electrical distribution systems and the systems needed for their continued operation was adequate. The team found the program for the control of industry information to have been well organized; however, problems with the timely implementation of the program were noted. The team was concerned about the lack of documented evaluations for operability determinations and with control and update of information contained in the USAR.

6. OVERALL CONCLUSIONS

The team concluded that the design of the WCGS electrical distribution system was superior. The team found the ready availability of design documentation to be a program strength. The team also considered most of the maintenance and testing procedures and activities to be good. The team was, however, concerned about the lack of documentation to support operability determinations. A more detailed discussion of the overall conclusions is provided in the Executive Summary.

7. EXIT MEETING

The team met with the personnel listed in paragraph 1 on April 10, 1992, and summarized the scope and findings of the inspection. Licensee personnel acknowledged the inspection findings. Although some proprietary information was reviewed by the team during the course of the inspection, no proprietary information has been incorporated into this report.

ATTACHMENT 1

INSPECTION FINDINGS INDEX

1. Revision to the USAR in the following areas:

   - EDG load required by the ESW pump motors (paragraph 2.3.1)
   - EDG Fuel Oil Day Tank volume requirements (paragraph 3.1.2)
   - Site design ambient temperature values (paragraph 3.2.2)
   - ESW flow rate requirements (paragraph 5.2.3)

   These changes are all part of IFI 9201-01.

2. Revision of the drawings which indicate the electrical load requirements for the inverters to reflect recent recalculation of the connected loads. (paragraph 2.4.6; IFI 9201-02)

3. Acceptability of the orientation of the EDG lube oil relief valves which are mounted horizontally. (paragraph 4.6.2; IFI 9201-03)

4. Modifications to the control circuitry for the ESW self-cleaning strainers. (paragraph 5.2.2; IFI 9201-04)

* Implementation of the fuse control program will continue to be followed in response to IFI 9136-05. (paragraph 4.5)

ATTACHMENT 2